

2022 Lake Fairlee Water Quality Monitoring Results: Lay Monitoring Program and LaRosa Partnership Program

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VT Department of Environmental Conservation, UVM Lake Champlain Sea Grant





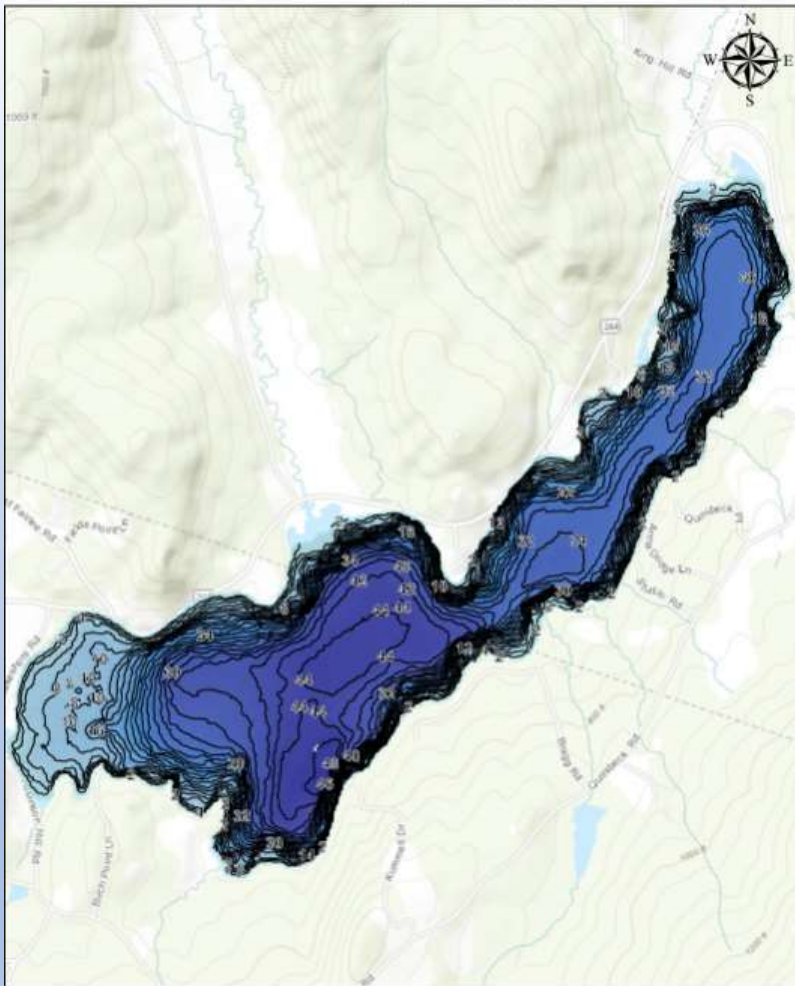
Lay Monitoring Program (LMP) Lake Sampling Overview

- Weekly from Memorial Day to Labor Day (minimum of 8 samples for summer mean):
 - *Basic Sampling*: Measure Secchi disk transparency depth (clarity)
 - *Supplemental Sampling*: Collect water samples that are lab tested for total phosphorus (nutrient) concentration and chlorophyll-a (algae) concentration
 - Complete a lake sampling webform (and report cyanobacteria conditions)



<https://dec.vermont.gov/watershed/lakes-ponds/monitor/lay-monitoring>

Lake Fairlee, Fairlee, VT



Legend

Depth (ft.)

High : 0

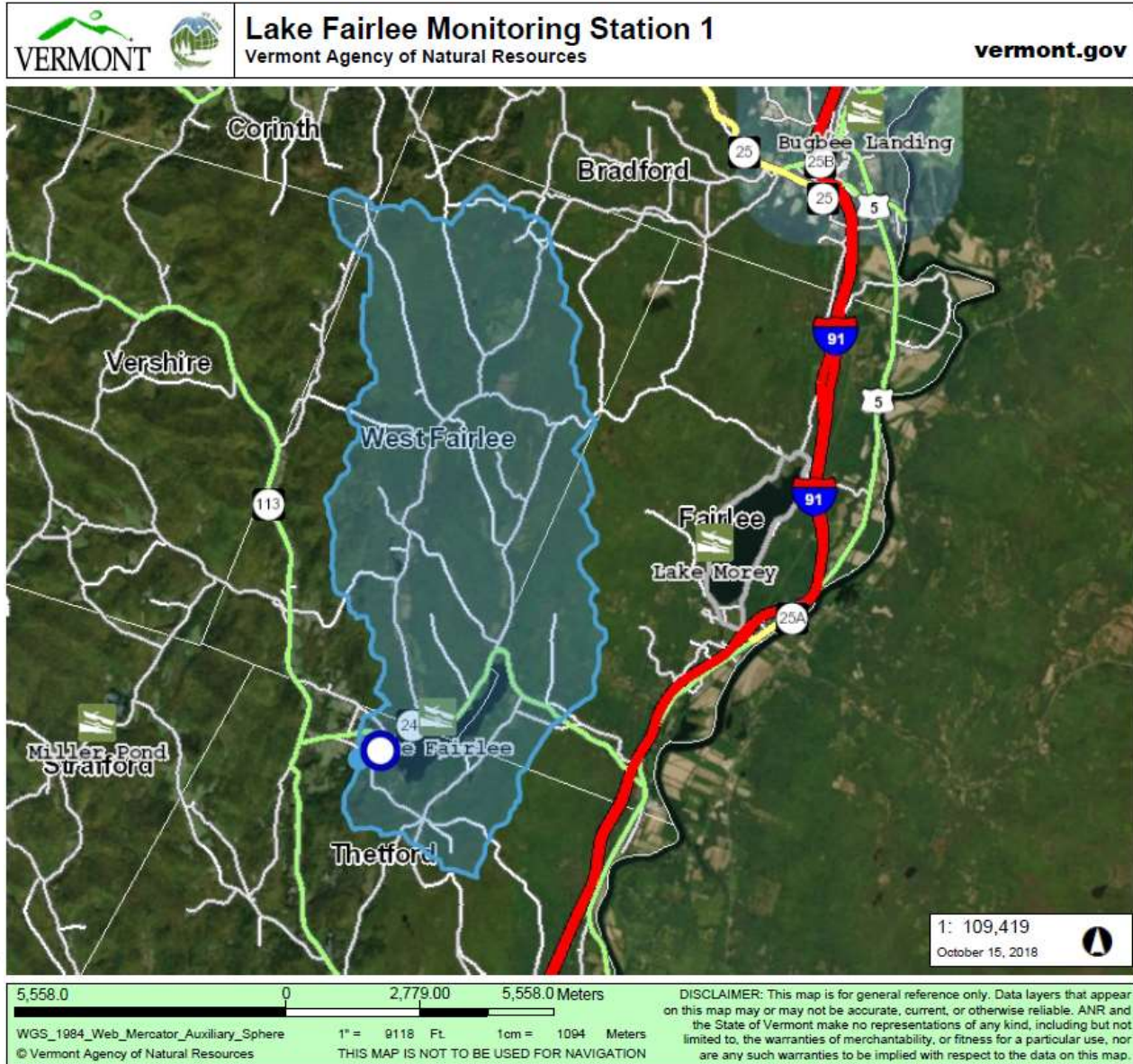


Low : 48

Depth Contour (2 ft.)

Source Data Collected: 8/27/2018

0 0.125 0.25 0.5 Miles



Vermont Lake Score Card

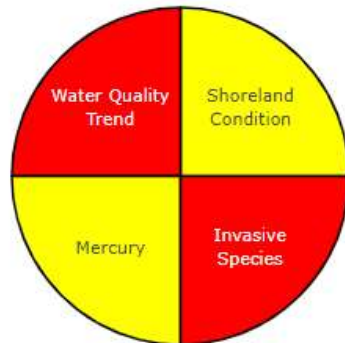
Lake Fairlee

<https://dec.vermont.gov/watershed/lakes-ponds/data-maps/scorecard>

Scores

Water Quality Data

Lake Information



Watershed: Moderately Disturbed

WQ Standards: Stressed

Details

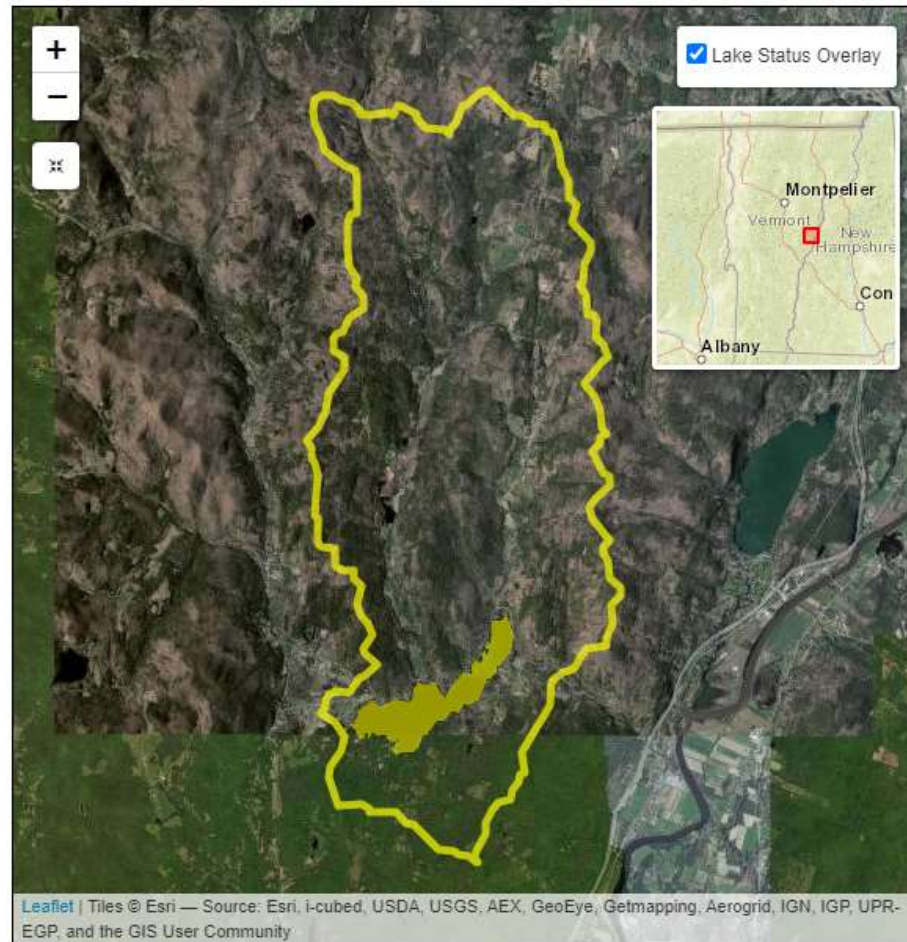
Stressed – Nutrients

Stressed – Phosphorus

Color Scoring System

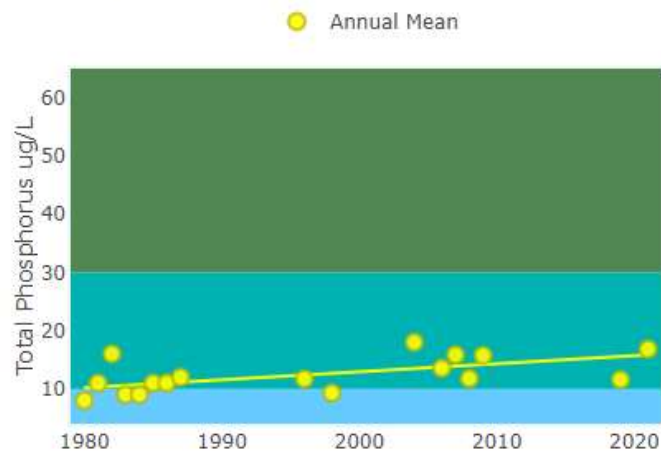
- Good Conditions
- Fair Conditions
- Poor Conditions
- Insufficient Data

[Learn How Lakes Are Scored](#)



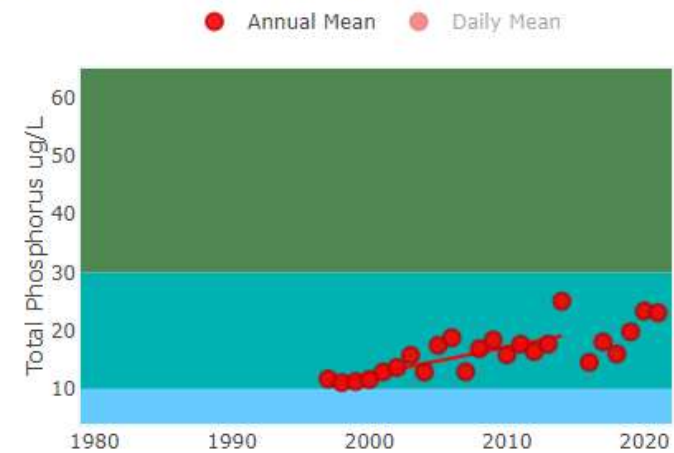
Spring Phosphorus

Trend: Significantly Increasing (p-value=0.0131)



Summer Phosphorus

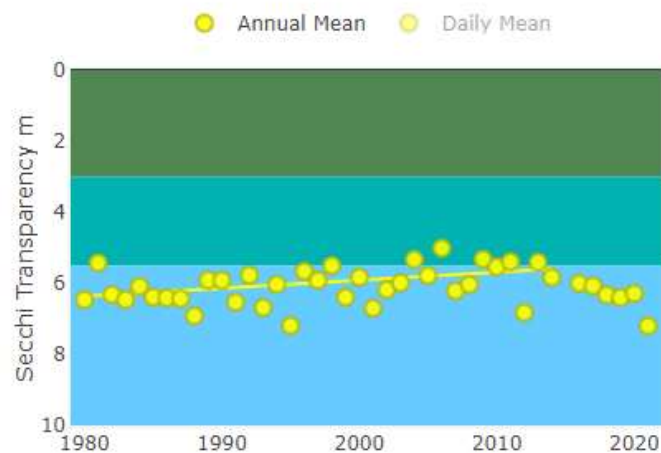
Trend: Highly Significantly Increasing (p-value=1e-04)



LAKE FAIRLEE SCORE CARD WATER QUALITY TRENDS

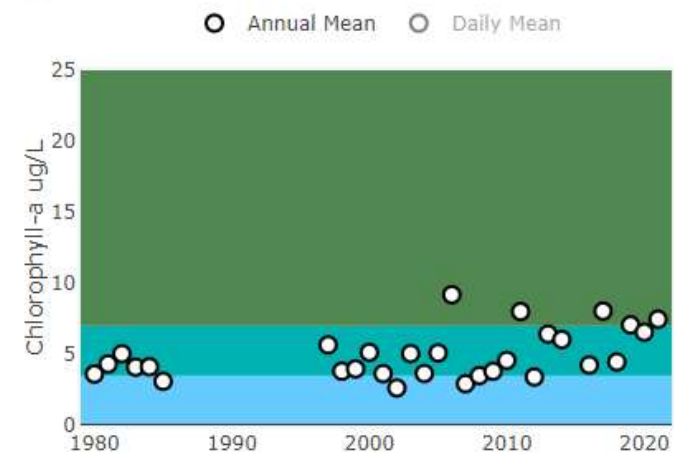
Summer Secchi

Trend: Significantly Decreasing (p-value=0.0198)



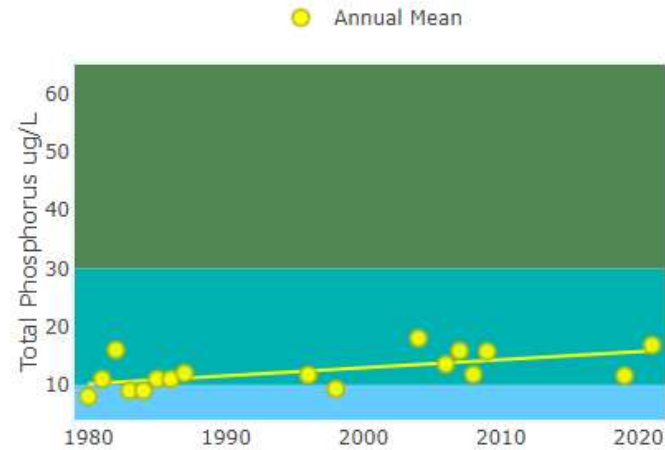
Summer Chlorophyll-a

Trend: Stable (p-value=0.4273)



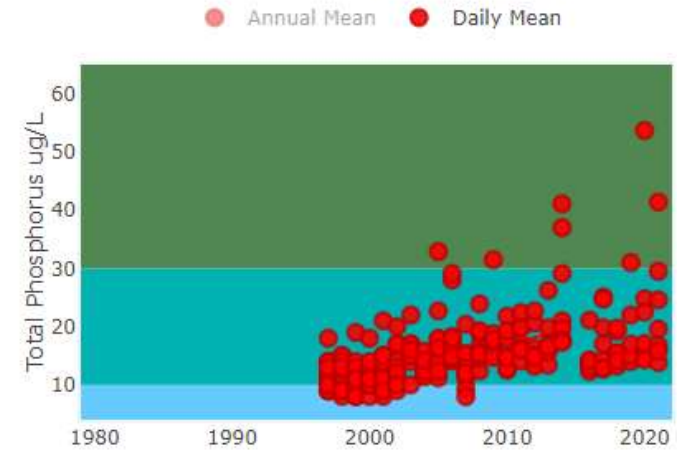
Spring Phosphorus

Trend: Significantly Increasing (p-value=0.0131)



Summer Phosphorus

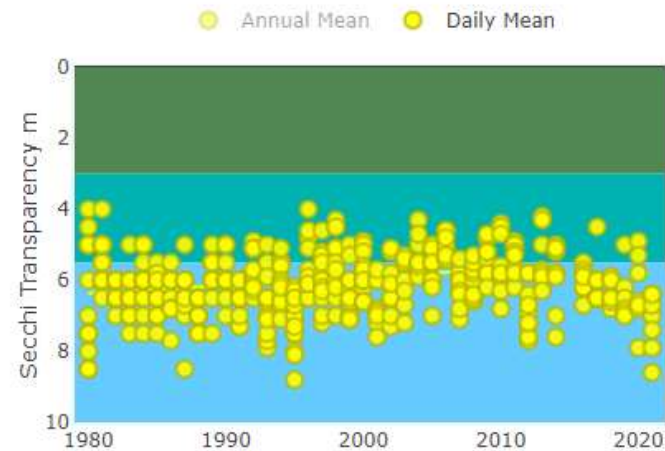
Trend: Highly Significantly Increasing (p-value=1e-04)



LAKE FAIRLEE SCORE CARD WATER QUALITY TRENDS

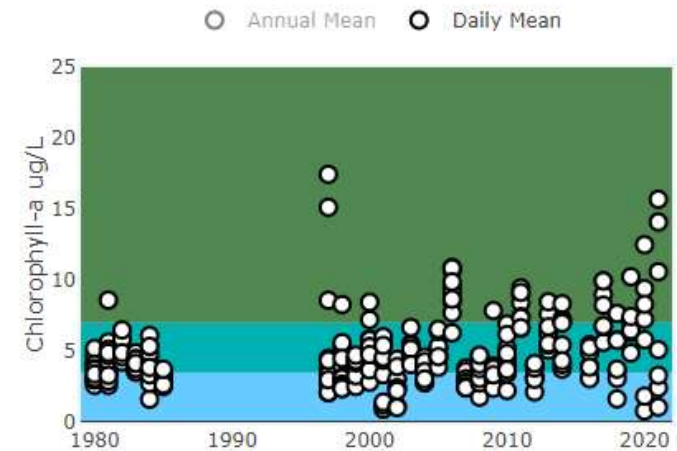
Summer Secchi

Trend: Significantly Decreasing (p-value=0.0198)

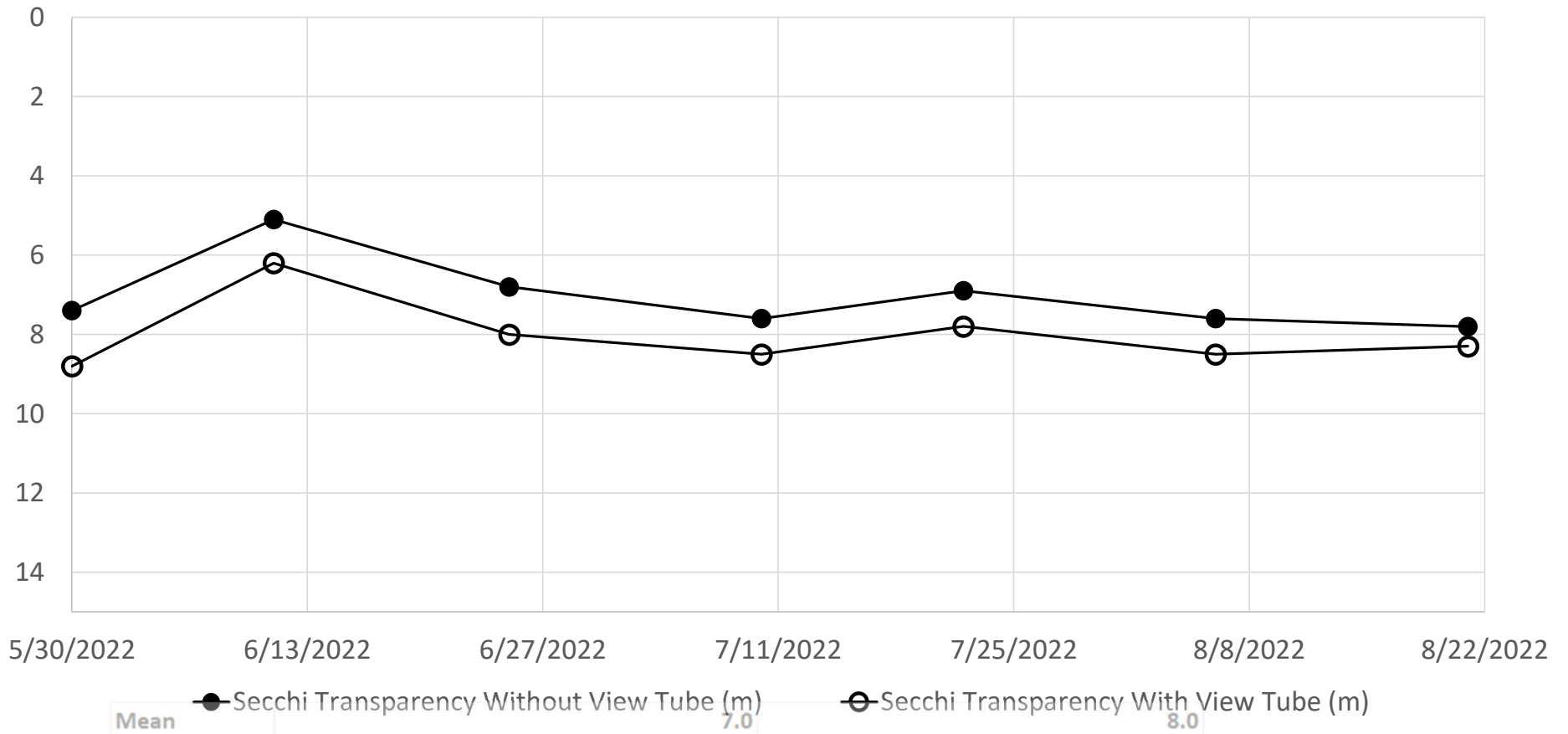


Summer Chlorophyll-a

Trend: Stable (p-value=0.4273)

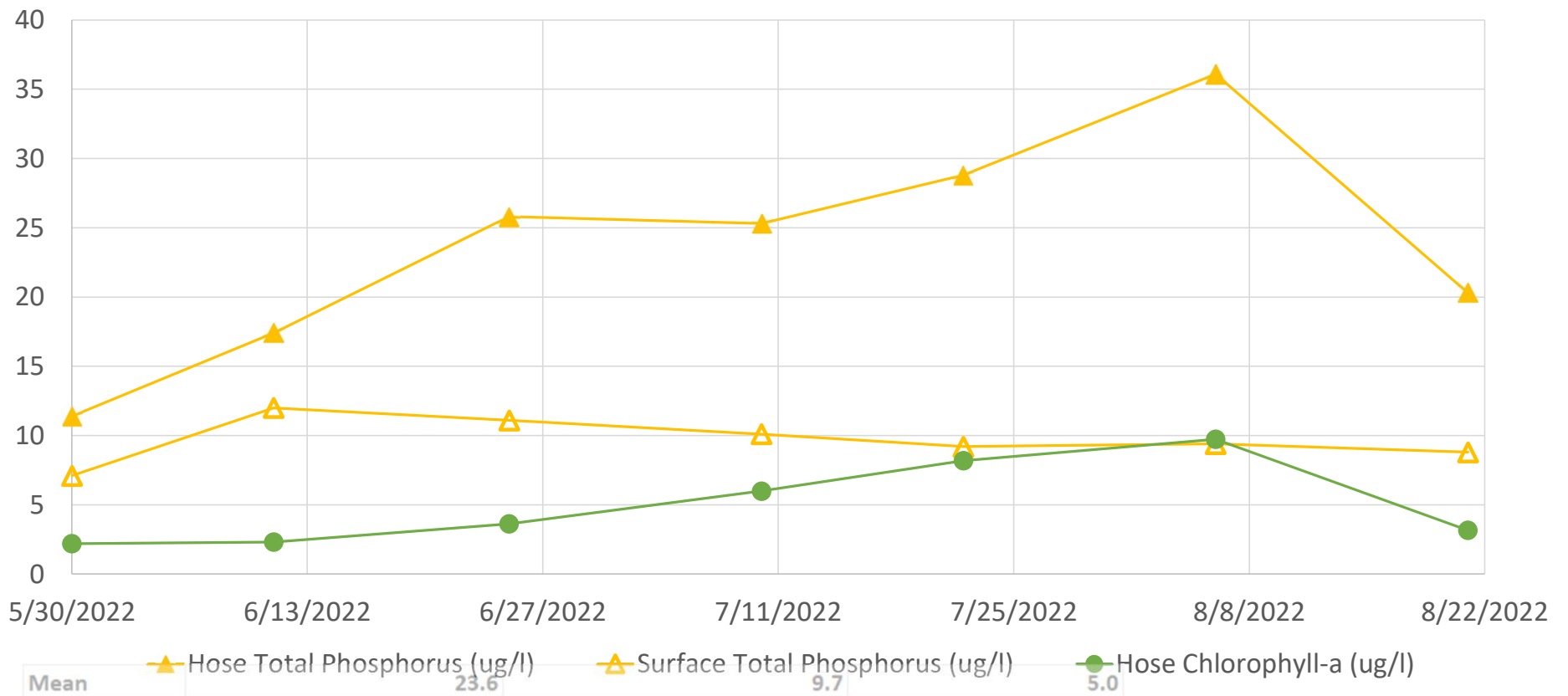


2022 Lake Fairlee Lay Monitoring Secchi Transparency Results

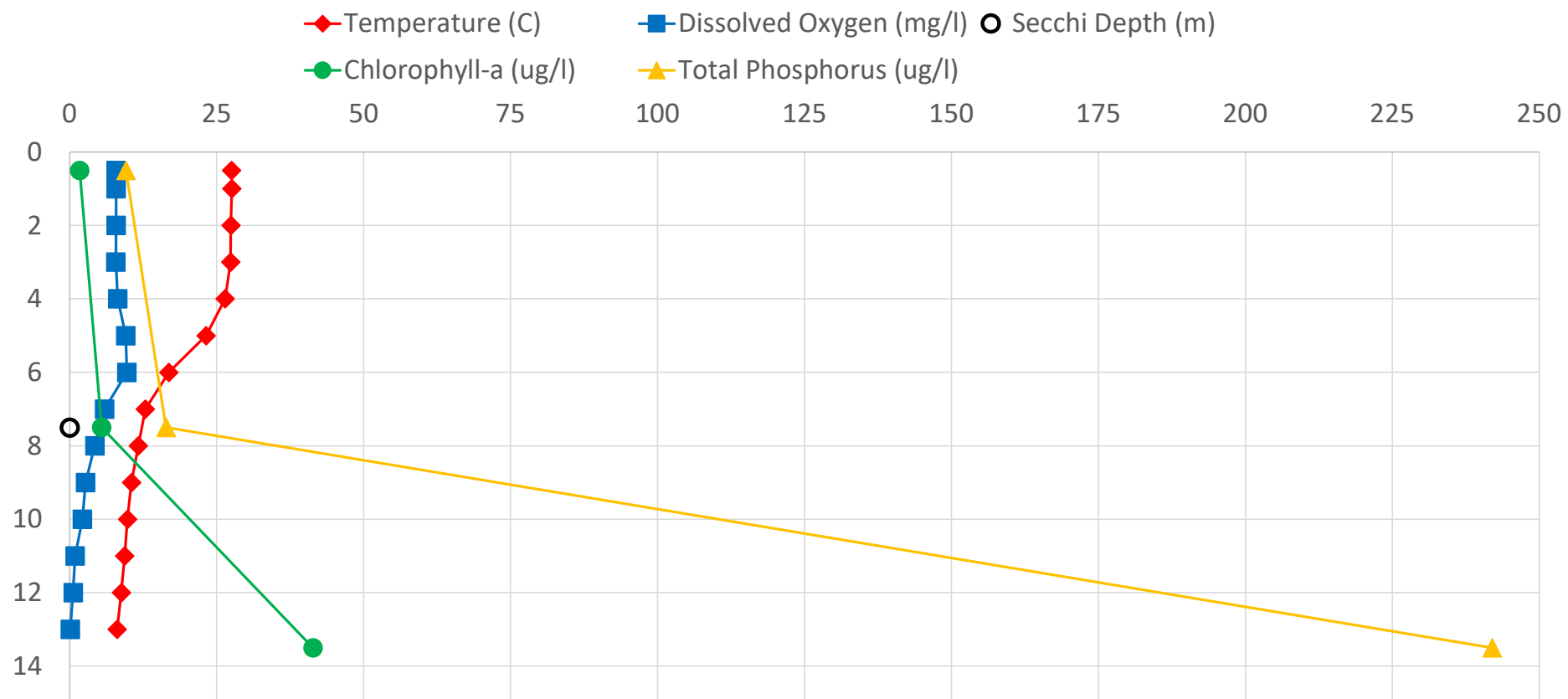


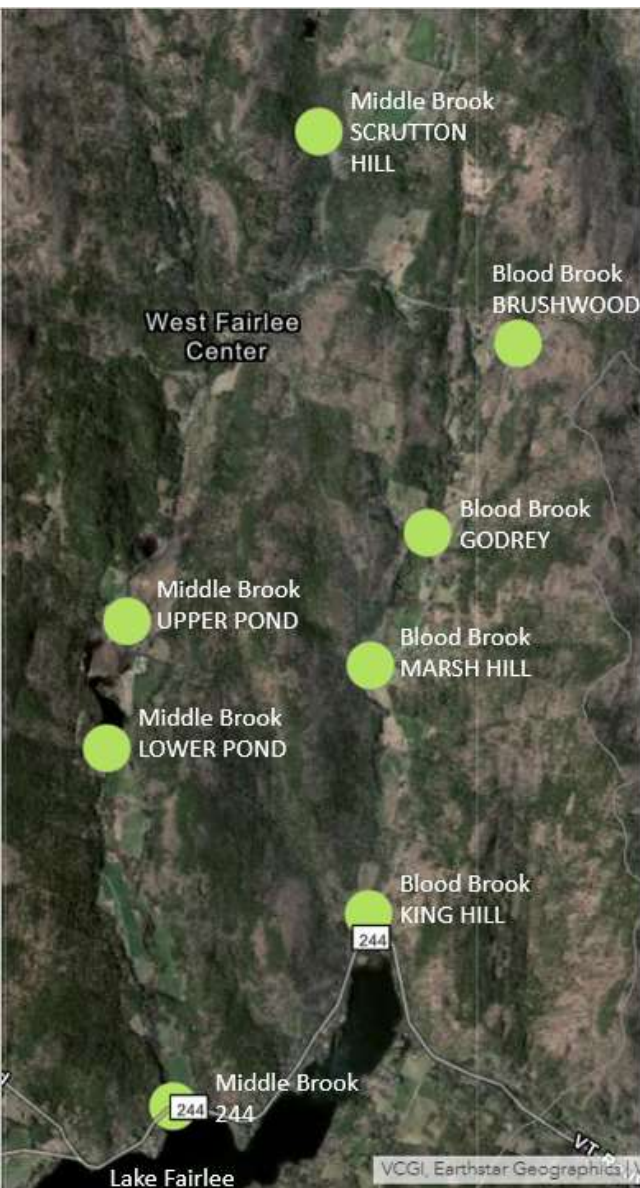
2022 Lake Fairlee Lay Monitoring Total Phosphorus and Chlorophyll-a Results

(Note: Integrated Hose Sample Depth ~ 13.5 m; Surface Grab Sample Depth ~ 0.5 m)



8/8/2022 Lake Fairlee Water Quality Vertical Profile





LaRosa Partnership Program (LPP) Tributary Sampling Overview

- Since 2021, sampled biweekly from April/May to July/August
- Blood Brook Sites (total phosphorus 2021-2022)
 - King Hill: inlet to lake
 - Marsh Hill (2022): bracketing of agriculture
 - Godfrey: bracketing of agriculture
 - Brushwood: baseline near headwaters (also chloride)
- Middle Brook Sites (total phosphorus 2021-2022)
 - Route 244: inlet to lake (also chloride)
 - Lower Middle Brook Pond (2022): bracketing of agriculture
 - Upper Middle Brook Pond (2022): bracketing of agriculture
 - Scrutton Hill: baseline near headwaters (also chloride)

<https://dec.vermont.gov/watershed/map/monitor/larosa>

LPP Sample Parameters Overview:

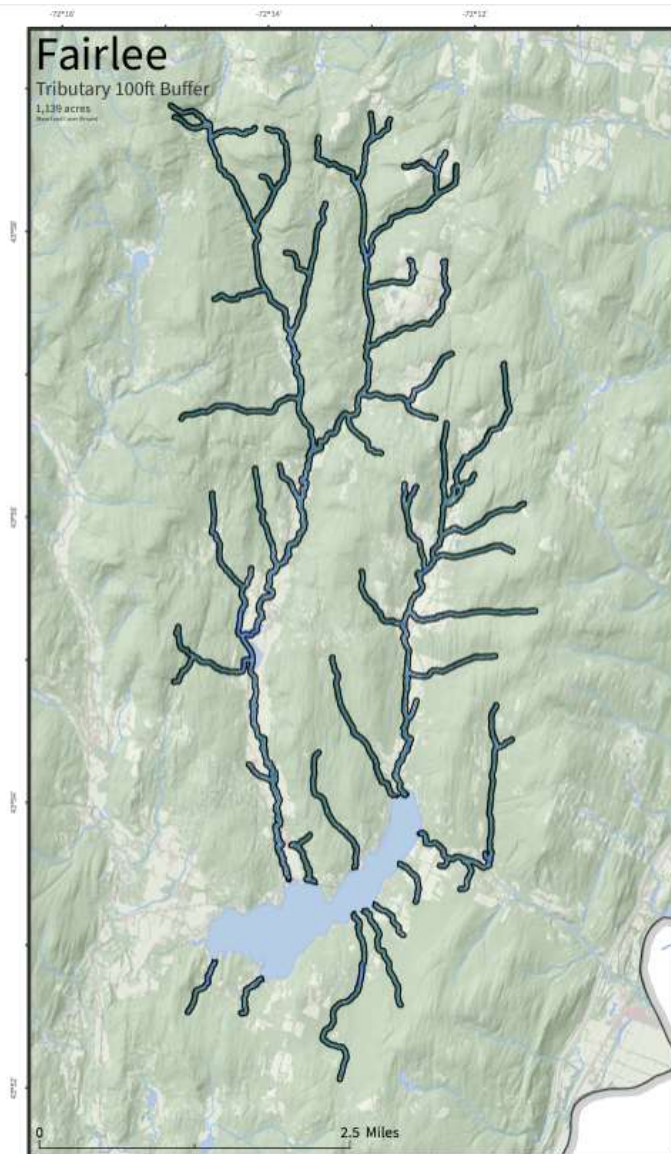
Total Phosphorus & Chloride

Total Phosphorus

- Sources
 - Developed land runoff, roads, driveways
 - Fertilizers – lawns and agriculture
- Impacts
 - Feeds plants, algae and cyanobacteria
 - Aesthetics, Recreation, Aquatic Life Uses
- Vermont Water Quality Standards Nutrient Criteria for Aquatic Life Use
 - Not to be exceeded at low median monthly flow (baseflow) during June through October
 - 12 ug/L for small high gradient streams (SHG)
 - 15 ug/L for medium high gradient streams (MHG)
 - 27 ug/L for warm-water medium gradient streams and rivers (WWMG)

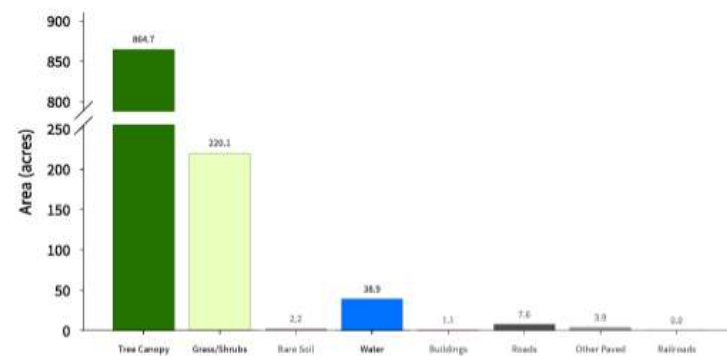
Total Chloride

- Sources
 - Road salt
 - Wastewater, water softeners
- Impacts
 - Affects chemical processes of biological organisms
 - Aquatic Life Use
- Vermont Water Quality Standards Chloride Criteria for Aquatic Life Use
 - 860 mg/L maximum (acute)
 - 230 mg/L average (chronic)
 - Studies show chloride can impact organisms at lower concentrations



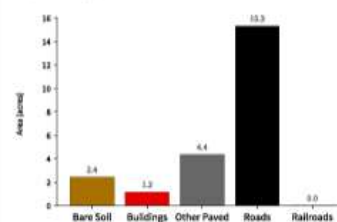
High-Resolution Land Cover Summary

Base Land Cover (Top-Down*)

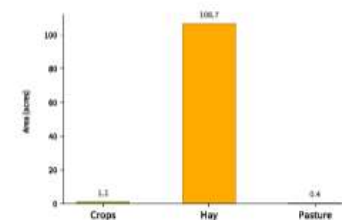


Supplemental Land Cover

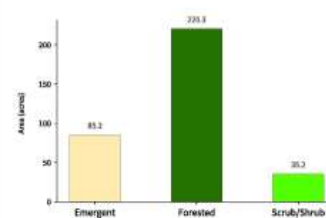
Impervious Surfaces (23.28 acres - 2 % of total) (Bottom-Up**)



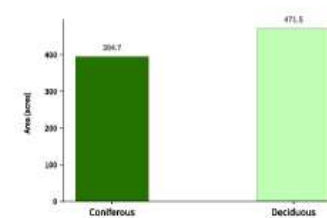
Agriculture (108.31 acres - 9.5 % of total)



Wetlands (340.65 acres - 29.9 % of total)



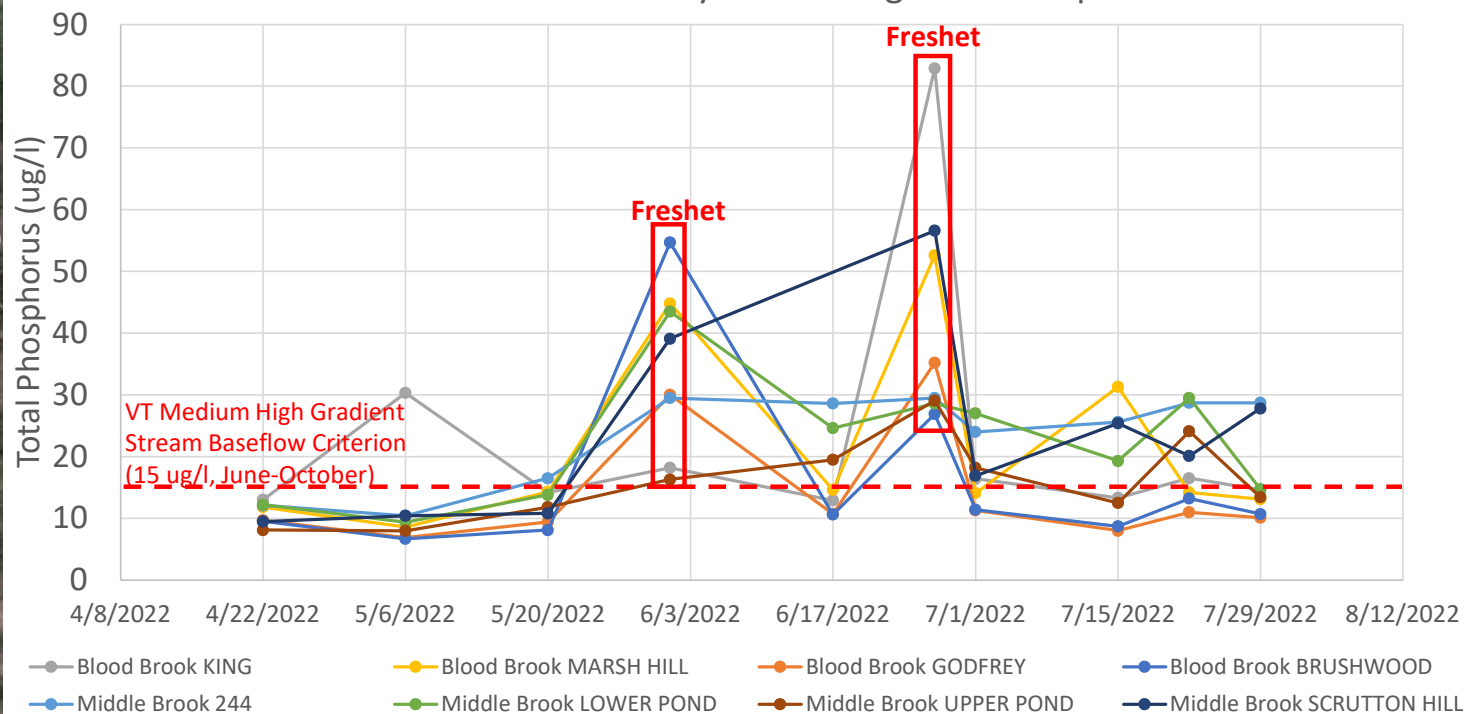
Tree Canopy (866.16 acres - 76 % of total)



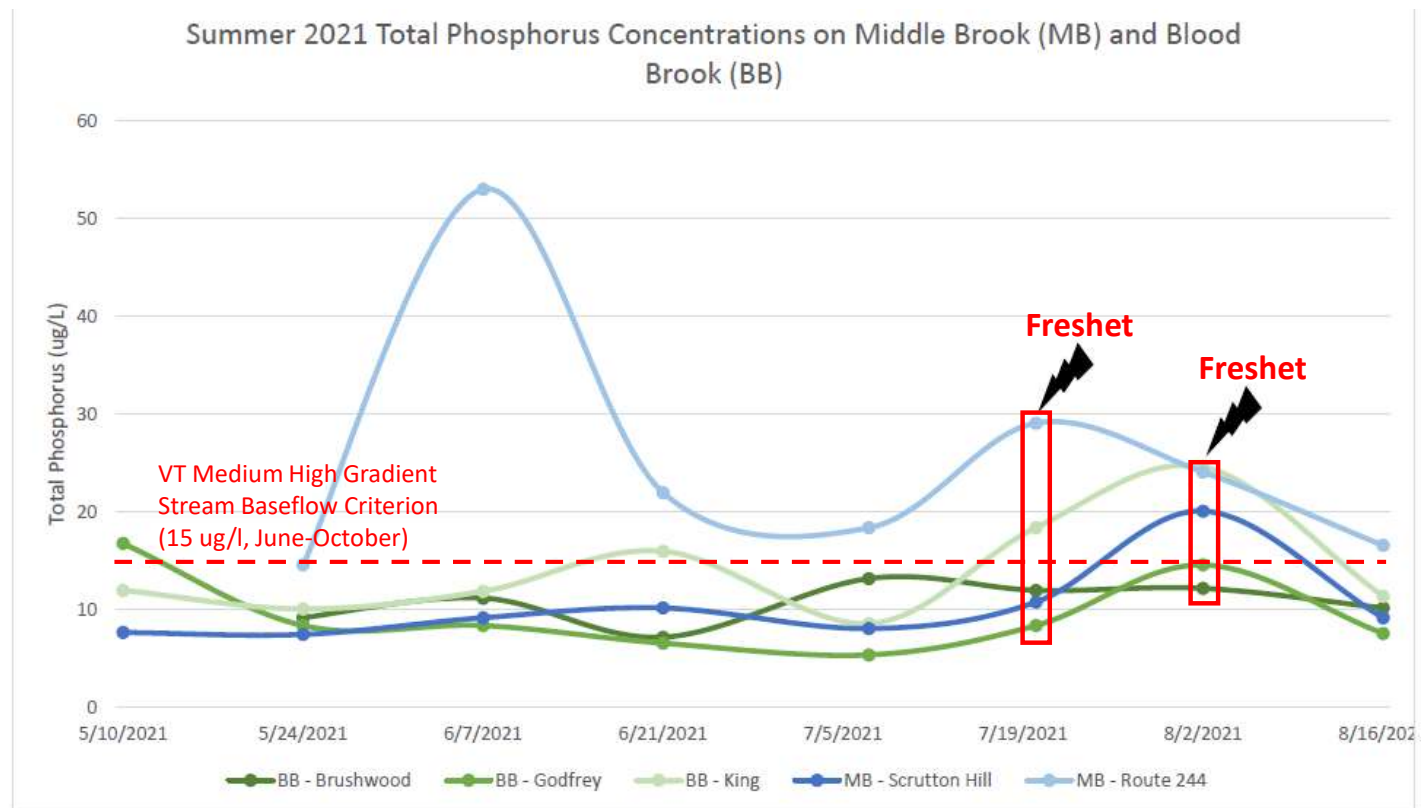
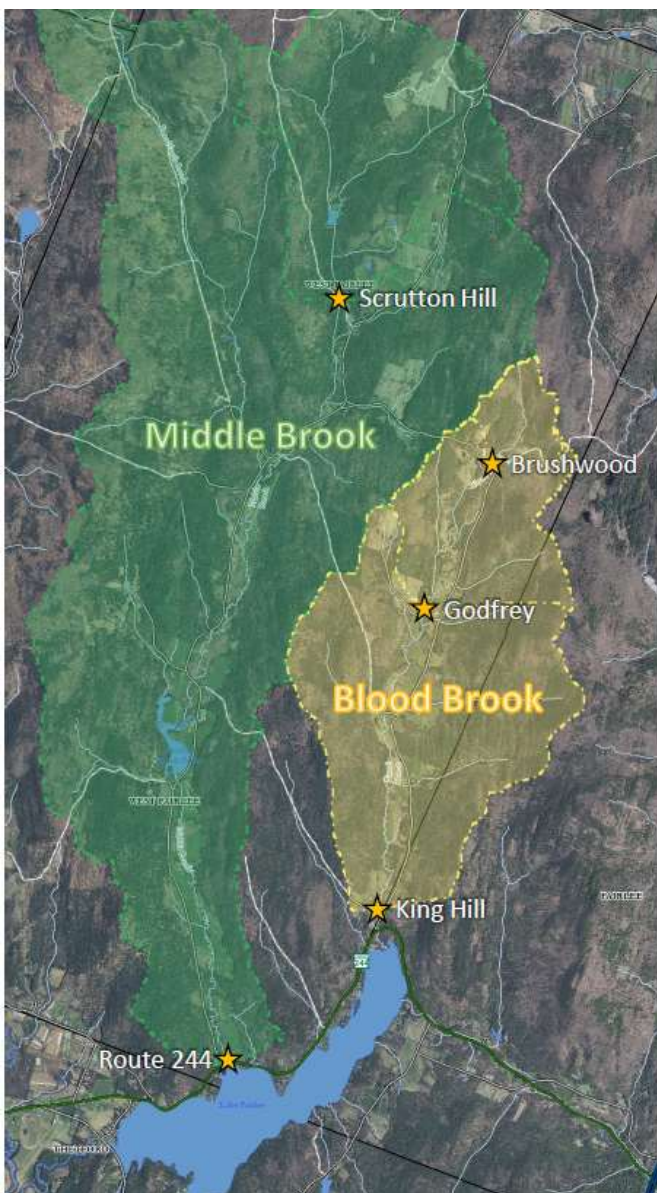
*Top-Down: A satellite or aerial image mapping approach - land cover is mapped as the observed land cover class.
 **Bottom-Up: A field-based mapping approach - land cover is mapped as the observed land cover class. This approach results in improved mapping of boundaries and is often used by other studies.
 Data: USDA National Wetlands Inventory (2010) and USDA Forest Service (2010).



2022 Lake Fairlee LaRosa Tributary Monitoring Total Phosphorus Results



Tributary Site	Minimum TP (ug/l)		Average Baseflow TP (ug/l)		Maximum TP (ug/l)	
	2022	2021	2022	2021	2022	2021
Blood Brook KING HILL	12.9	7.4	16.4	11.1	82.9	24.6
Blood Brook MARSH HILL	8.6	NA	15.3	NA	52.6	NA
Blood Brook GODFREY	6.9	5.4	9.6	8.9	35.2	16.8
Blood Brook BRUSHWOOD	6.7	7.2	9.9	10.2	54.7	13.2
Middle Brook 244	10.4	10.8	21.8	22.6	29.5	53
Middle Brook LOWER POND	9.4	NA	18.8	NA	43.5	NA
Middle Brook UPPER POND	8.0	NA	14.5	NA	29.1	NA
Middle Brook SCRUTTON HILL	9.5	7.5	17.3	8.7	56.6	20.1

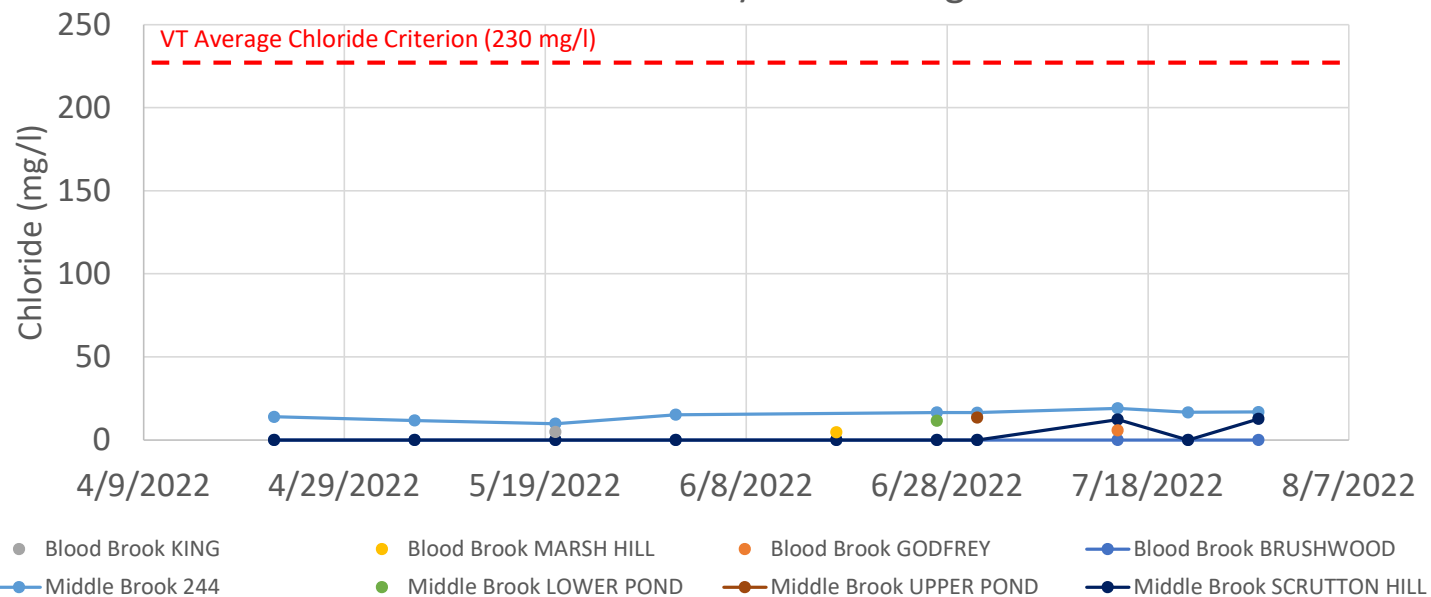


Location	Range	Median	Average	Geomean
Blood Brook - Brushwood	7.2 - 13.2	11.2	10.7	10.6
Blood Brook - Godfrey	5.4 - 16.8	8.4	9.3	8.7
Blood Brook - King	8.6 - 24.6	12.0	14.0	13.3
Middle Brook - Scrutton Hill - Upstream	7.5 - 20.1	9.2	10.4	9.9
Middle Brook - 244 - Downstream	14.6 - 53	20.2	24.5	22.5

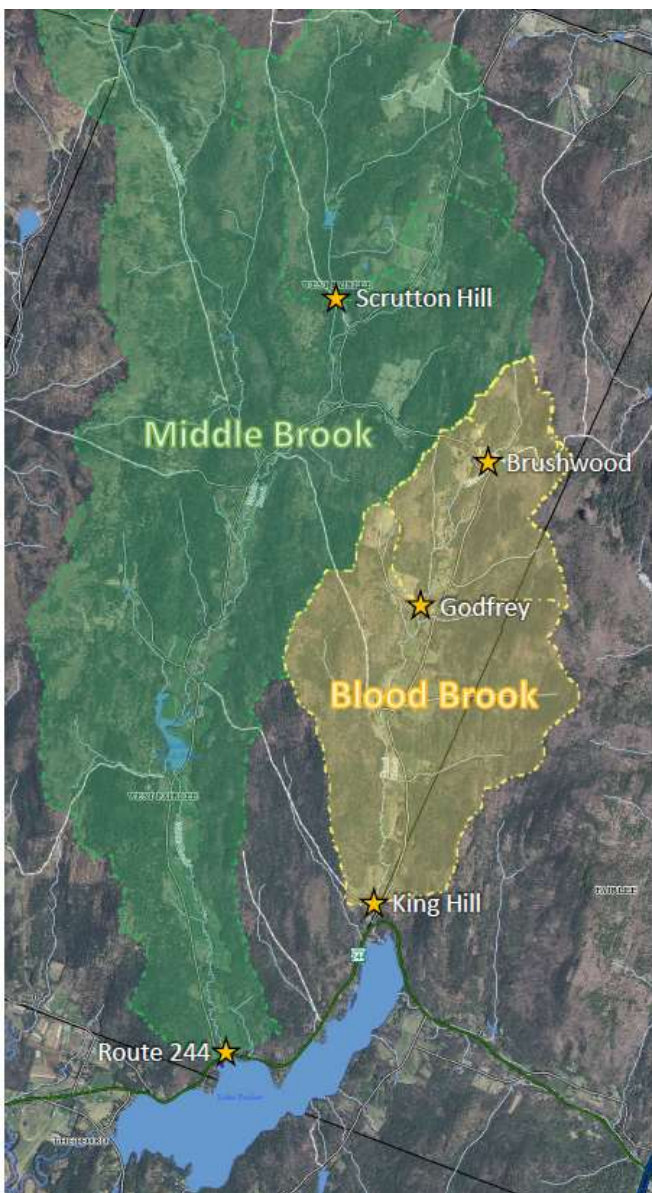
Pattern of TP increase upstream to downstream, except from Brushwood to Godfrey



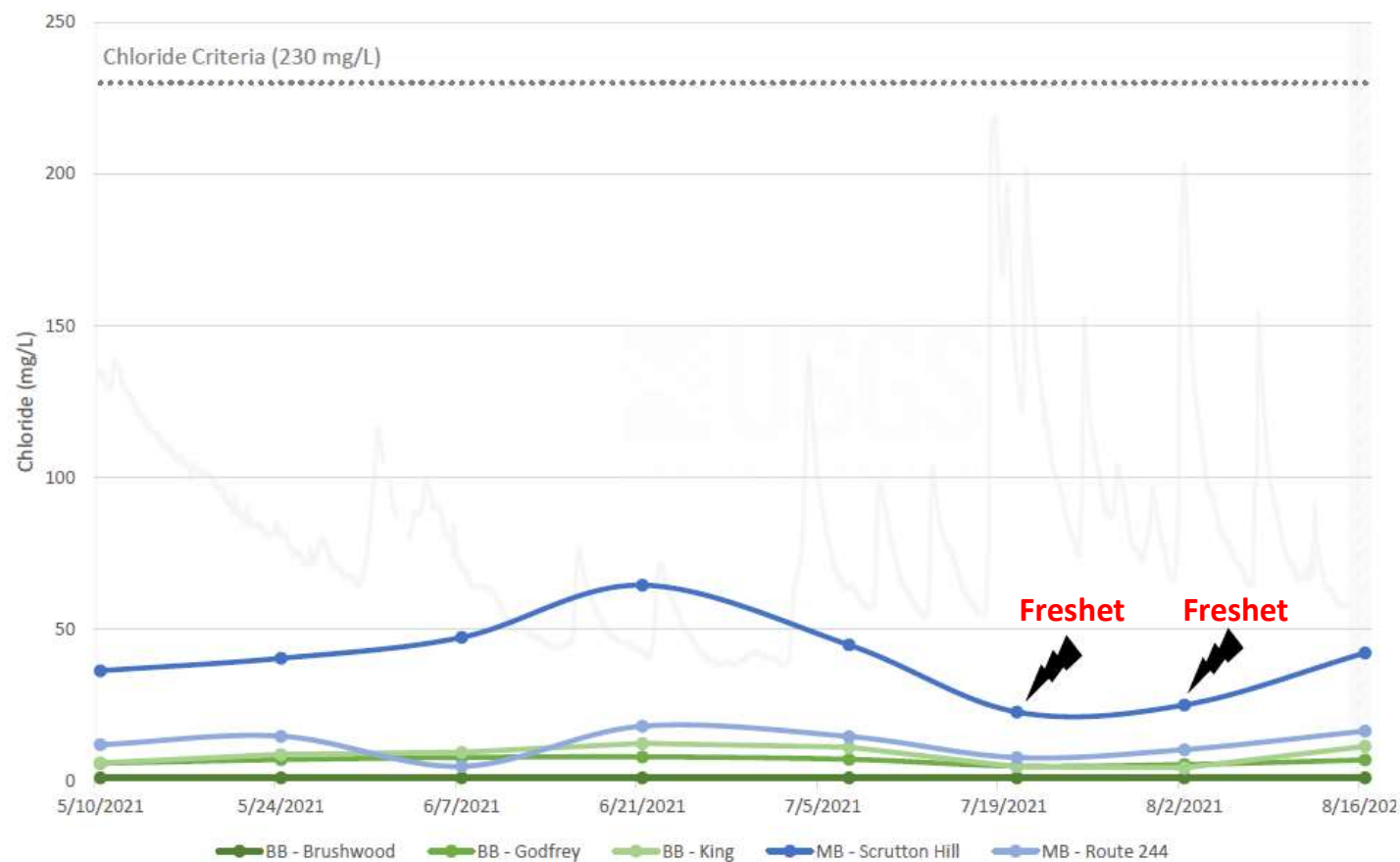
2022 Lake Fairlee LaRosa Tributary Monitoring Chloride Results



Tributary Site	Minimum Chloride (mg/l)		Average Chloride (mg/l)		Maximum Chloride (mg/l)	
	2022	2021	2022	2021	2022	2021
Blood Brook KING	4.7	4.3	NA	8.4	4.7	12.3
Blood Brook MARSH HILL	4.6	NA	NA	NA	4.6	NA
Blood Brook GODFREY	5.8	4.9	NA	6.6	5.8	7.9
Blood Brook BRUSHWOOD	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Middle Brook 244	9.8	4.8	15.1	13.4	19.0	22.5
Middle Brook LOWER POND	11.5	NA	NA	NA	11.5	NA
Middle Brook UPPER POND	13.5	NA	NA	NA	13.5	NA
Middle Brook SCRUTTON HILL	12.3	22.7	NA	40.4	12.6	64.5



Summer 2021 Total Chloride Concentrations on Middle Brook (MB) and Blood Brook (BB)



All sample results were below nutrient criteria values for chloride. Levels were slightly elevated on Scrutton Hill Road, potentially from road salts.

2022 Monitoring Summary & 2023 Next Steps

- Lay Monitoring Program (LMP)
 - 2022 Summary: Hose samples have much higher total phosphorus concentrations than surface samples due to internal loading from sediment
 - 2023 Next Steps: LMP volunteer collects biweekly surface and near-bottom samples while LMP coordinator collects monthly water quality vertical profiles
- LaRosa Partnership Program (LPP)
 - 2022 Summary: Downstream sites on Blood Brook and Middle Brook show higher baseflow/max total phosphorus concentrations; very low chloride
 - 2023 Next Steps: LPP volunteers continue collecting biweekly samples through August for only total phosphorus at all sites